Impervious Surface Delineation
How Feature Extraction Provides Return on Investment

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Agenda

- Impervious Surface Delineation (Traditional Methods)
- Impervious Surface Delineation (Feature Extraction)

QUESTIONS???

- Return on Investment
- Client Benefits
- Existing Clients
- Contracting Vehicles

WRAP-UP/QUESTIONS???

Impervious Surface Delineation
(Traditional Methods)

History

<u>Traditional Techniques to Create an Impervious Surface Layer</u>

- Utilize Traditional Photogrammetric Techniques
  - 3D capture of impervious features using stereo aerial imagery

History

Traditional Techniques to Create an Impervious Surface Layer

- Utilize Heads-up Digitizing Techniques
    - 2D capture of impervious features from ortho-imagery

History - Proposed Plans (CAD Drawings)

Impervious Surface Delineation
(Utilizing Feature Extraction)

Feature Extraction of Impervious Surfaces

Process:

- Semi-Automated Feature Extraction using Remote Sensing
  - Transforming Data into Information
    - Utilize base mapping (ortho-imagery and LiDAR)
    - Utilize existing GIS data (parcel mapping)
  - Integrating Impervious Surface Layer with Billing System

Feature Extraction of Impervious Surfaces

Input Datasets

- Digital Ortho-Imagery
  - 4-band (Red, Green, Blue, Near-Infrared)
  - 8- or 16-bit imagery
  - 6-inch or higher resolution
- Aerial LiDAR (Light Detection And Ranging)
  - 1-meter or denser point spacing
- Parcel Mapping
- Existing Base Mapping Layers

Feature Extraction of Impervious Surfaces

Input Datasets
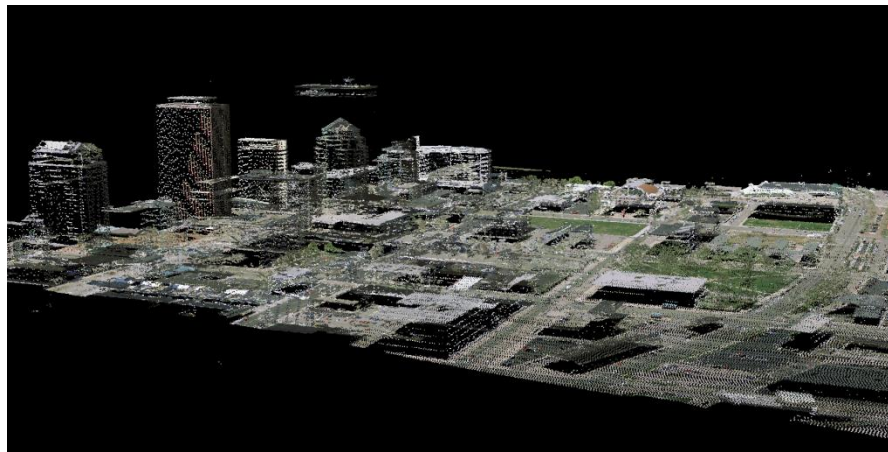
- Digital Ortho-Imagery

Natural Color

Color Infrared

Feature Extraction of Impervious Surfaces
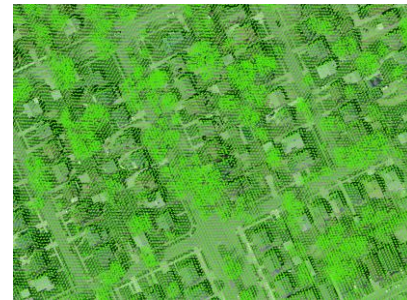
Input Datasets

- Aerial LiDAR (Light Detection And Ranging)
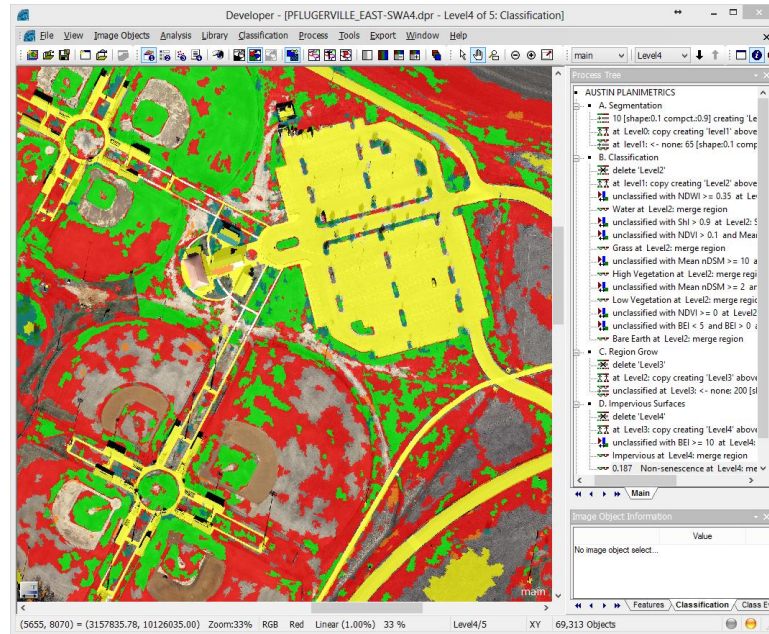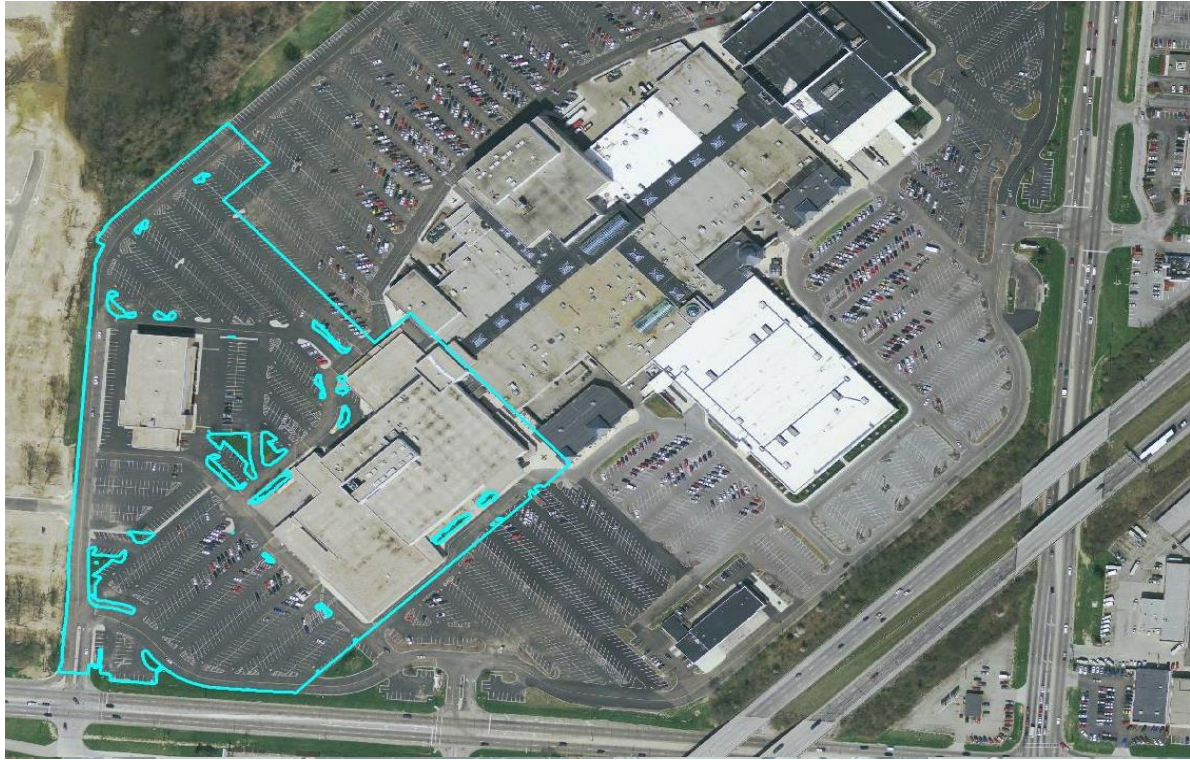 - 1-meter or denser point spacing

LiDAR Point Cloud

Intensity

Patterning

Feature Extraction of Impervious Surfaces

Object Oriented Remote Sensing

History – Existing VS. New Dataset

History – Proof-of-Concept Results

What are the results from the Pilot Area?

- EM Columbus LLC
    - Existing impervious area: 1,607,934 square feet
    - New automated impervious area: 1,610,123 square feet
    - Difference: 2,189 square feet
- Lazarus Inc.
    - Existing impervious area: 688,290 square feet
    - New automated impervious area: 702,434 square feet
    - Difference: 14,144 square feet
- Sears
    - Existing impervious area: 740,172 square feet
    - New automated impervious area: 752,723 square feet
    - Difference: 12,551 square feet

- Total existing impervious area: 3,036,396 square feet
- Total new impervious area: 3,065,280 square feet
- Difference: +**28,884 square feet**

History – Proof-of-Concept Results

Owner	# of ERUs	Stormwater Charges	Clean River Charges	Total Charges
Sears and Roebuck	370	$1,335.70	$865.80	$2,201.50
	376	$1,353.60	$879.84	$2,233.44
Difference	**6**	**$17.90**	**$14.04**	**$31.94**
Lazarus Inc	344	$1,283.12	$749.92	$2,033.04
	351	$1,305.72	$765.11	$2,070.83
Difference	**7**	**$22.60**	**$15.19**	**$37.79**
EM Columbus LLC	804	$2,894.40	$1,881.36	$4,775.76
	805	$2,898.00	$1,883.70	$4,781.70
Difference	**1**	**$3.60**	**$2.34**	**$5.94**

History – Proof-of-Concept Results

<u>Estimated Dollars Comparing LiDAR Data with Current Data</u>

<u>Owner</u>	<u>Total Charges</u>	<u>Comment</u>	<u>Annual Income</u>
Sears and Roebuck	$31.94	30 Day Billing Cycle	**$383.28**
Lazarus Inc	$37.79	31 Day Billing Cycle	**$453.48**
EM Columbus LLC	$5.94	30 Day Billing Cycle	**$71.28**
		Total Estimated Annual Income	**+$908.04**

- LiDAR – Light Detection and Radar
- ERU – Equivalent Residential Unit
- 1 ERU = 2,000 Square Feet

History – Citywide Impervious Surface Extraction Non-Residential Parcels
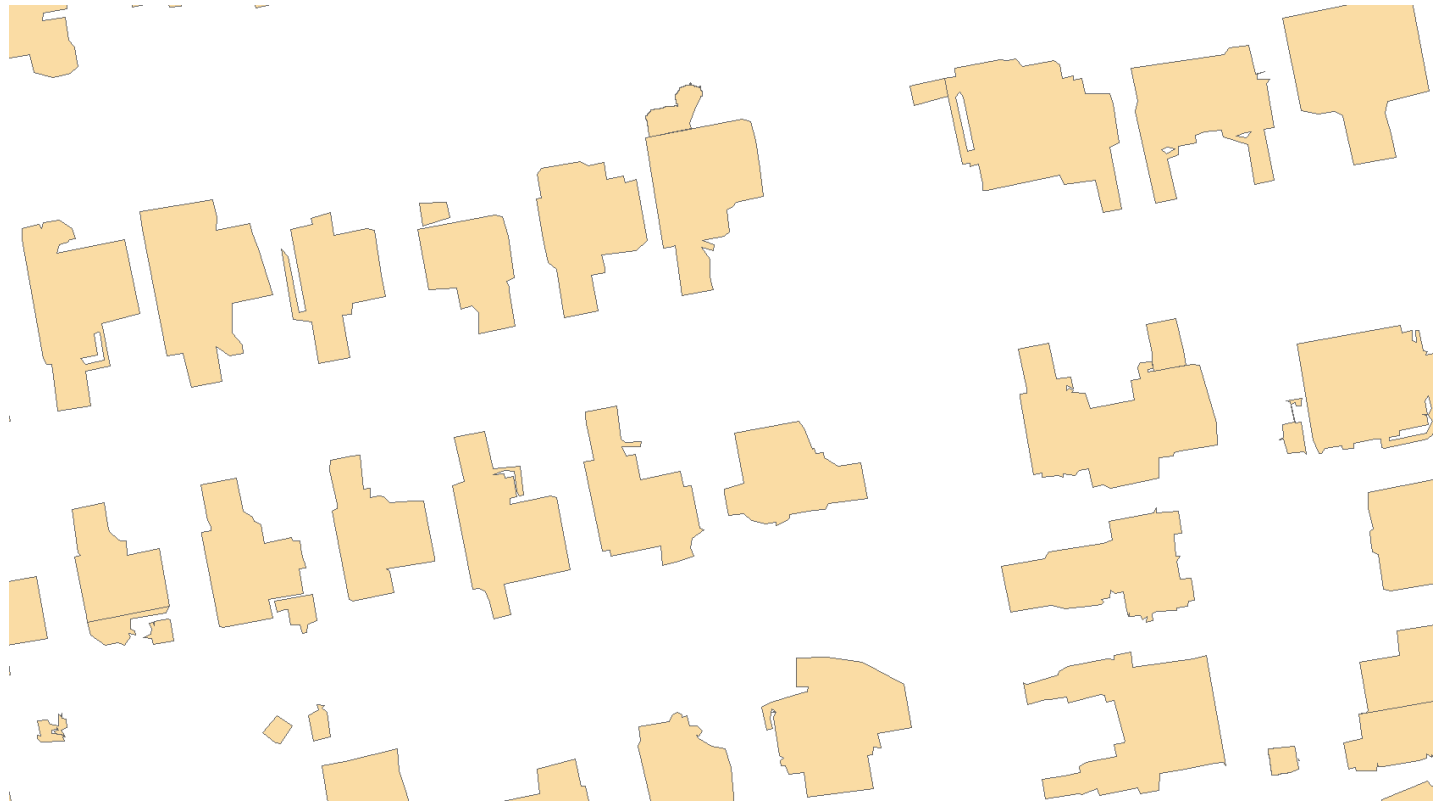
History – Citywide Results

Decrease from existing impervious surface area

Increase from existing impervious surface area

History – Residential Parcel Test Sample

History – Residential Parcel Test Sample

City of Columbus, Ohio

Residential Impervious Surface Pilot Area Calculation

Area	Parcel Count	Impervious Surface Total (Sq. Ft.)	Old Sq.Ft	Old Fee Monthly	New Fee Monthly	Difference	Old Fee Yearly	New Fee Yearly	% Change
Franklinton	152	256480.532	304000	$980.40	$827.15	($153.25)	$11,764.80	$9,925.80	-15%
German Village	289	693749.797	578000	$1,864.05	$2,237.34	$373.29	$22,368.60	$26,848.08	20%
Hilliard	261	981239.977	522000	$1,683.45	$3,164.49	$1,481.04	$20,201.40	$37,973.88	88%
Worthington	72	343320.525	144000	$464.40	$1,107.20	$642.80	$5,572.80	$13,286.40	138%

Questions?

Return on Investment Analysis

Return on Investment Analysis

- City of Columbus, Ohio
- City of Indianapolis, Indiana
- City of Springfield, Ohio

Return on Investment Analysis

Case Study #1 – City of Columbus, Ohio

- Population of 822,553 (2013 estimate)
- Service Area: ~700 square miles
- Non-Residential Parcels Only

	ERU (Equivalent Residential Unit)	Fee (monthly)	Square Feet
Existing			
New			
Difference	150,800	$425,000	301,600,000
Change			

Return on Investment Analysis

Case Study #2 – City of Indianapolis, Indiana

- Population of 843,393 (2013 estimate)
- Service Area: ~400 square miles
- Non-Residential Parcels Only

	BBU (Base Billing Units)	Fee (monthly)	Square Feet
Existing	1,470,935	$1,618,028	1,446,468,367
New	1,525,640	$1,678,204	1,517,728,074
Difference	54,705	$60,175	71,259,707
Change	4%	4%	5%

Return on Investment Analysis

Case Study #3 – City of Springfield, Ohio

- Population of 59,357 (2013 estimate)
- Service Area: ~30 square miles
- Non-Residential and Residential Parcels
    - Residential parcels are on a tiered system

	ESU Equivalent Service Unit)	Fee (monthly)	Square Feet
Existing	78,473	$100,537	141,930,800
New	85,697	$112,094	162,659,093
Difference	7,224	$11,557	20,728,293
Change	9%	11%	15%

Return on Investment Analysis

Realized Return (first year)

    3x – 5x client initial investment

- Example: City of Indianapolis, Indiana
- $235,000 initial investment
- $722,106 realized annual return

Annual Return (2nd year and beyond)

- $722,106 Additional Annual Revenue (Indianapolis, Indiana)

Client Benefits

Advantages of Using Feature Extraction For Impervious Surface Delineation

- Provide a fair assessment of impervious surfaces
- Provide a streamlined and cost effective process
- Decrease human error
- Analysis of multiple data sources – strengthen results
- Reproducible/repeatable results
- Maintain an up-to-date and accurate impervious surface dataset
- Release technicians to perform other tasks

Existing Clients

Current/Existing Clients

- City of Springfield, OH
- City of Columbus, OH
- Pennsylvania DEP
- City of Indianapolis, IN
- City of Hobart, IN
- City of Hamilton, OH

Contracting Vehicles

Available Contracting Vehicles

Types of Contracting Available

- Statewide Imagery/LiDAR – E.g. Ohio, Indiana
- State Term Contracts – E.g. GIS State Term
- Grants – Fed, State
- GSA – Fed
- Existing Stormwater Utility Contracts –
- Federal – NOAA, USGS
- RFP, RFQ, SOQ – E.g. Indianapolis

Thank You

Questions???